

Journal of Physics A: General Physics

Volume 5, 1972

General
Physics

**BLANK
PAGE**

Vol.
19

Volume 5

1972

Pages L1-136, 1-1756

**Journal of
Physics A**

General Physics



**A Europhysics Journal
published by
The Institute of Physics**

Copyright © 1972 by The Institute of Physics and individual contributors. All rights reserved. Multiple copying of the contents or parts thereof without permission is in breach of copyright, but permission is hereby given to copy titles and abstracts of papers and names of authors. Permission is usually given upon written application to the Institute to copy illustrations and short extracts from the text of individual contributions, provided that the source (and, where appropriate, the copyright) is acknowledged.

General
Physics

Vol
19

Published by The Institute of Physics, 47 Belgrave Square, London SW1X 8QX,
England, in association with the American Institute of Physics.

Printed in Great Britain by J W Arrowsmith Ltd. Set in 10/12 pt Times New Roman.

Journal of Physics A: General Physics

Honorary Editor

Professor R G Chambers PhD

Editorial Board

R Balian Eng Mines

Professor L L Green PhD FInstP

Professor P L Marsden PhD FInstP

E R Pike PhD FIMA FInstP *Deputy Chairman*

Professor F A E Pirani PhD DSc

Professor D Sette Ding

Professor E J Squires PhD FInstP

M F Sykes DPhil

J B Taylor PhD FInstP FRS

Professor J G Valatin Ding DSc

Managing Editor

DG Fisher PhD FInstP

Assistant Editor

Mr J A Revell BSc

**BLANK
PAGE**

Contents

NO 1 JANUARY 1972

LETTERS TO THE EDITOR

- L1 C D Ciubotariu · A barometric formula in relativistic magnetohydrodynamics
L3 S Swain · An exact solution of the multiatom, multimode model Hamiltonian of quantum optics
L7 H C Kelly and J G Blake · A measurement of pulse separations for photoelectrons in the case of a Lorentz spectral line
L10 P T Greenland and J M Irvine · K shell electron wavefunctions in complex atoms
L13 P B Dunscombe, C O Blyth, J S C McKee and C Pope · Neutron polarization from the $D(d,n)^3He$ reaction at 10.8 MeV incident deuteron energy
L15 N H Hancock, G J Hardisty and F H Read · Mechanical simulation of the diffusion of long macromolecules
L17 D Ray · Neutrino processes in the lepton era of the universe and hot big bang cosmology
L19 P Bandyopadhyay · Solar neutrinos and the ^{37}Cl neutrino absorption experiment

REVIEW ARTICLES

- 1 F W Brasse · Electroproduction experiments
27 S J Goldsack · Multiparticle interactions

PAPERS

Mathematical Physics

- 67 T Morita and T Horiguchi · Analytic properties of the lattice Green function
78 S Dvořák · Treloar's distribution and its numerical implementation
85 S Dvořák · Asymptotic behaviour of the chain molecule distribution function
95 S Katsura and M Ohnishi · Distribution of zeros of the partition function for the one dimensional Ising models

Quantum Electronics and Quantum Optics

- 104 H C Kelly · Spatial correlations and photon counting

Elementary Particle and Nuclear Physics

- 112 M S Stern and A E A Warburton · Finite difference solution of the partial-wave Schrödinger equation
125 P R Blake, H Ferguson and W F Nash · Muon bundles in large EAS

Fluids

- 132 T J M Boyd and J G Turner · Optical mixing in a magnetized plasma
146 V K Tripathi and J Kamal · Resonant excitation of ion plasma waves by VLF and whistler waves
152 B E Keen and W H W Fletcher · Nonlinear plasma instability effects for subharmonic and harmonic forcing oscillations
166 M V Berry, R F Durrans and R Evans · The calculation of surface tension for simple liquids

Solid State Spectroscopy and Optical Properties

- 171 J Hue and R Mainard · A method of resolving the Boltzmann quantum equation in the field of electronic relaxation

NO 2 FEBRUARY 1972

LETTERS TO THE EDITOR

- L25** *D N Pant* · The external field of a nonstatic isolated system in Bonnor's unified field theory
L28 *L Basano* · A note on Lorentz-covariant theories of gravitation
L30 *A L Harvey* · Comment on Coleman's theory of gravitation
L31 *E Soczkiewicz* · Concerning Rao's rule

REVIEW ARTICLE

- 179** *B Borgia* · Results from storage rings

PAPERS

Mathematical Physics

- 198** *M A Rotenberg* · Loss of gravitational mass of a rotating rod as outgoing gravitational radiation
211 *J C Hargreaves* · Composite models in general relativity
231 *A Norcliffe* · Relating the classical and quantal theories of angular momentum and spin
241 *E Domany* · An expansion of two particle harmonic oscillator wavefunction products
246 *R Phythian* · Comments on the paper 'On Phythian's perturbation theory for stationary homogeneous turbulence'
248 *D G Fincham and P C Wraight* · A simple method for the analysis of damped oscillations
256 *D S F Crothers* · Analytic continuation of hypergeometric functions by complex single loop Euler transforms

Electromagnetism and Electrodynamics

- 263** *L C Robinson and L B Whitbourn* · Quantum mechanical description and noise analysis of the cyclotron resonance spectrometer-detector

Optics, Diffraction Theory

- 272** *M V Berry* · On deducing the form of surfaces from their diffracted echoes

Elementary Particle and Nuclear Physics

- 292** *F El Bedewi, A Goned and A H Girgis* · Energy spectrum and angular distribution of cosmic ray muons in the range 50–70 GeV
302 *J L Durell, P R Alderson, D C Bailey, L L Green, M W Greene, A N James and J F Sharpey-Schafer* · Lifetimes and decay modes of energy levels in ^{23}Na , ^{26}Mg and ^{26}Al

Fluids

- 318** *D Daba* · The interpretation of the effect of climbing up electrodes of the dielectric liquids in stationary fields (the Sumoto effect)

NO 3 MARCH 1972

LETTERS TO THE EDITOR

- L33** *C Pope, N Bugei, C O Blyth, P B Dunscombe and J S C McKee* · A search for spin-dependent effects in the three body final state from the $^2\text{H}(d, n)\text{pd}$ reaction at 11.3 MeV incident deuteron energy
L37 *O Singh, N Dass and N C Varshneya* · Comments on the theoretical derivation of Wada's and Rao's relations

REVIEW ARTICLE

- 327 *E Gabathuler* · Vector mesons

PAPERS

Mathematical Physics

- 348 *R P Moya and J G Valatin* · Chiral currents as field variables in a semiclassical approach
 365 *Y Fukui and T Morita* · Motion of an impurity atom in a lattice of harmonically coupled atoms and the stationary generalized Langevin equation
 374 *A Barnes* · Static perfect fluids in general relativity
 394 *R Tiwari and D N Pant* · Nonexistence of isolated charged monopoles in unified field theories
 401 *N D Sen Gupta* · On the quantum theory of dispersion at resonance
 411 *S G Whittington and J F Harris* · Numerical investigation of closure approximations in the selfavoiding walk problem

Electromagnetism and Electrodynamics

- 417 *P L Knight* · Effects of external fields on the Lamb shift

Elementary Particle and Nuclear Physics

- 426 *M S Stern* · Simple numerical solution of the partial-wave Lippmann-Schwinger equation
 431 *M L G Redhead* · Radiative corrections to coincidence experiments in high energy electron-electron and positron-electron scattering
 444 *E Kiraly, P Kiraly and J L Osborne* · Underground range fluctuations of high energy muons for various energy loss parameters
 454 *P J Nolan, D C Bailey, P E Carr, L L Green, A N James, J F Sharpey-Schafer and D A Viggars* · Lifetime measurements for levels in ^{30}P between 3.7 and 4.7 MeV excitation energy
 460 *M S Pöwar and M Singh* · Contribution of detour transitions to internal bremsstrahlung spectrum of ^{204}Tl
 468 *B V Thirumala Rao, J Rama Rao and E Kondaiah* · Neutron capture cross sections at 25 keV

Fluids

- 471 *S R Sharma and T N Bhainagar* · Propagation of waves perpendicular to the magnetic field in a two-component warm plasma

NO 4 APRIL 1972

LETTERS TO THE EDITOR

- L39 *C S Curran, T E Drake, A Johnston, S W Brain, W A Gillespie, E W Lees, R P Singhal and A G Slight* · Nuclear charge distributions of the isotopes ^{24}Mg , ^{25}Mg and ^{26}Mg from elastic electron scattering
 L43 *T J M Boyd, R H C Newton and P M Woodison* · Temperature gradient-induced instability in a solid state plasma

PAPERS

Mathematical Physics

- 479 *J Krishna Rao* · Spherical gravitational collapse with escaping neutrinos
 489 *M J Morris* · Interpolation theory for quantum mechanics
 495 *R Bourret* · Classical parastochastics and quantum mechanics; some observations
 499 *R V Gopala Rao and K Narasinha Swamy* · Selfconsistent PY2 and CHNC2 approximation. Evaluation of fifth virial coefficients

Electromagnetism and Electrodynamics

- 506 *G J Pert* · Inverse bremsstrahlung absorption in large radiation fields during binary collisions—classical theory
 516 *F Watt* · Electron-microwave interactions
 524 *R A McCorkle and W H Bennett* · Electrostatic self-focusing of electron streams

Quantum Electronics and Quantum Optics

- 534 *D F Walls and C T Tindle* · Nonlinear quantum effects in optics
 546 *G I Peters and L Allen* · Amplified spontaneous emission IV. Beam divergence and spatial coherence

Elementary Particle and Nuclear Physics

- 555 *K J Barnes, P H Dondi and S C Sarkar* · General form of the SU(3) Gürsey matrix
 563 *J M Charap and P T Davies* · Parametrization of SU(3) orbits in E_8
 569 *S C Tonwar, S Naranan and B V Sreekantan* · Search for massive interacting particles near the cores of extensive air showers of energies of about 2×10^{14} – 10^{16} eV
 584 *A Watt* · Angular momentum projection from nonaxial intrinsic states
 596 *D C Bailey, P E Carr, J L Durell, L L Green, M W Greene, A N James, J F Sharpey-Schafer and D A Viggars* · A study of the principal decay modes and lifetimes of levels in ^{29}Si below 7.2 MeV

NO 5 MAY 1972**PAPERS****Mathematical Physics**

- 605 *L Marder* · Sources for Kerr type space-times in general relativity
 608 *R L Hall* · Many-particle systems
 612 *E M Wittenles and G Carmi* · A soluble one dimensional model of an interacting Fermi gas: I
 624 *M F Sykes, D S Gaunt, P D Roberts and J A Wyles* · High temperature series for the susceptibility of the Ising model I. Two dimensional lattices
 640 *M F Sykes, D S Gaunt, P D Roberts and J A Wyles* · High temperature series for the susceptibility of the Ising model II. Three dimensional lattices
 653 *M F Sykes, A J Guttmann, M G Watts and P D Roberts* · The asymptotic behaviour of selfavoiding walks and returns on a lattice
 661 *M F Sykes, D S McKenzie, M G Watts and J L Martin* · The number of selfavoiding rings on a lattice
 667 *M F Sykes, D L Hunter, D S McKenzie and B R Heap* · Specific heat of a three dimensional Ising ferromagnet above the Curie temperature II
 674 *R Alexander-Katz and S F Edwards* · The statistical mechanics of entangled polymers

Quantum Electronics and Quantum Optics

- 682 *S K Srinivasan and S Sukavanam* · Photocount statistics of gaussian light of arbitrary spectral profile
 695 *L Allen and G I Peters* · Spectral distribution of amplified spontaneous emission

Quantum Field Theory

- 705 *J D Jenkins* · An equivalent theorem for a massive spin one particle interacting with Dirac particles in quantum field theory

Elementary Particle and Nuclear Physics

- 717 *M S Stern and A E A Warburton* · Numerical determination of Regge poles in potential scattering
 726 *P A Collins, B J Hartley, R W Moore, K J M Moriarty and G W Parry* · A Veneziano model, with absorptive corrections, for higher spin production

736 S A Adjei, P A Collins, B J Hartley, R W Moore and K J M Moriarty · A Veneziano model with cuts for KN and KN charge-exchange scattering

745 J C Barton and C M Pourgoirides · A study of the nonionizing component of the cosmic radiation underground

Fluids

763 M Rama Rao, P Sen and A P Patro · Three quantum annihilations in silicone fluids

767 G J Davies and J Chamberlain · High accuracy submillimetre-wave solution measurements

Astrophysics

773 W N Charman and J V Jelley · A search for pulses of fluorescence produced by supernovae in the upper atmosphere

NO 6 JUNE 1972

LETTERS TO THE EDITOR

L49 E Jakeman · The effect of heterodyne detection on the statistical accuracy of optical linewidth measurements

L53 C A Ayre, C J Hume, B C Nandi, M G Thompson, S C Wells, M R Whalley and A W Wolfendale · An improved measurement of the charge ratio of cosmic ray muons in the range 10–300 GeV/c

PAPERS

Mathematical Physics

781 J Katz · A note on energy extremal properties for rotating stars in general relativity

786 G A Maugin · Relativistic theory of magnetoelastic interactions I

803 J O'Hanlon · Mach's principle and a new gauge freedom in Brans-Dicke theory

812 D C Khandekar and S V Lawande · Path integral for a three body problem

Quantum Electronics and Quantum Optics

820 J C Eilbeck and R K Bullough · The method of characteristics in the theory of resonant or nonresonant nonlinear optics

Elementary Particle and Nuclear Physics

830 K J Barnes · Canonical second rank tensors for chiral $SU(3) \times SU(3)$

838 D Fincham · Multiple scattering model for pion-nucleon scattering and the slope of the Pomeranchuk trajectory

853 I G Halliday, S Islam and G Parry · The ABST model and high energy scattering

859 R H Vatcha, B V Sreekantan and S C Tonwar · Study of high energy (25–10 000 GeV) interactions with a multiplate cloud chamber using Monte Carlo simulations for energy calibration

877 K Siddappa, M Sriramachandra Murty and J Rama Rao · p wave neutron capture in medium and heavy weight nuclei

Fluids

881 T J M Boyd and J G Turner · Lagrangian studies of plasma wave interactions I

897 W G Scaife · The relative permittivity of the n alkanes from n pentane to n decane as a function of pressure and temperature

Astrophysics

904 S Karakula, J L Osborne, E Roberts and W Tkaczyk · The anisotropy of cosmic rays of galactic origin above 10^{17} eV

916 ADDENDUM

NO 7 JULY 1972

LETTERS TO THE EDITOR

- L57** *D C Khandekar and S V Lawande* · Path integration of a three body problem
L60 *J L Martin* · Selfavoiding walks on a crystal lattice; a new approach to the mean-square end-to-end length ρ_e
L62 *R Burman* · A photon rest mass and the dispersion of longitudinal electric waves in interstellar space

REVIEW ARTICLES

- 917** *G Goldring* · Hyperfine interactions of excited nuclei in highly ionized atoms
929 *H J Mang* · Collective motions and single particle models

PAPERS

Mathematical Physics

- 936** *J S Dowker* · Quantum mechanics and field theory on multiply connected and on homogeneous spaces
944 *S Feneuille and A Crubellier* · Quaternionic solutions for the relativistic Kepler problem with magnetic charges
950 *R Lee* · A two-particle Green function self-energy expansion
965 *S F Edwards and A G Goodyear* · The dynamics of a polymer molecule
981 *A R Choudhary and R B Jones* · Analyticity of partial wave scattering amplitudes and conformal mapping methods

Thermodynamics

- 1004** *P G Wright* · Revised thermodynamic relations for λ transitions in mixtures I. Examination in terms of properties generally relevant
1015 *P G Wright* · Revised thermodynamic relations for λ transitions in mixtures II. Special relations for Curie points and Néel points
1018 *P G Wright* · Revised thermodynamic relations for λ transitions in mixtures III. The saturated vapour of solutions of ^3He in liquid ^4He below their λ temperatures

Quantum Field Theory

- 1025** *P C W Davies* · Extension of Wheeler-Feynman quantum theory to the relativistic domain II. Emission processes
1037 *J D Jenkins* · Some remarks on an equivalence theorem for an interacting massive spin one particle in quantum field theory

Elementary Particle and Nuclear Physics

- 1043** *K J Barnes and R Delbourgo* · Matrix and tensor constructions from a generic $\text{SU}(n)$ vector
1054 *K O Thielheim and R Zöllner* · The theory of the longitudinal development of electromagnetic cascades
1073 *G D Jones, E M Jayasinghe, P J Mulhern, I G Main and P J Twin* · Spin assignments for some higher excited states in ^{34}S
1090 *J D Kellie, M N Islam, D B C B Syme and G I Crawford* · Neutron total cross section of ^{31}P between 0.75 MeV and 9.00 MeV

Fluids

- 1095** *B E Keen and M W Alcock* · Growth rate and frequency dispersion characteristics of drift waves in an RF collisional plasma
1108 *H C Barr and T J M Boyd* · Surface waves in hot plasmas
1119 *R H Varey and L B Kapp* · Experimental evidence for supersonic ion flow in a low pressure plasma

NO 8 AUGUST 1972

LETTERS TO THE EDITOR

- L65** *G S Joyce* · Lattice Green function for the simple cubic lattice
L69 *A J Hartley, R Chapman, G D Dracoulis, S Flanagan, W Gelletly and J N Mo*
 The ground state rotational bands in ^{150}Sm and ^{151}Sm
L74 *B E Keen* · Asynchronous excitation of a plasma instability
L78 *R Burman* · A photon rest mass and the absorption of longitudinal electric waves in interstellar space

PAPERS

Mathematical Physics

- 1123** *L M Debees* · On the Temple lower bound for eigenvalues
1131 *J Killingbeck* · Group algebras and tensor operators
1138 *C M Farmer* · Distribution functions in virial and hypervirial theory
1152 *T L John and K L Williams* · Variational trial functions in quantum theory I. Bound states
1165 *T L John and K L Williams* · Variational trial functions in quantum theory II. Continuous spectrum
1176 *J L Martin* · Phase transitions in a one-dimensional model of a ferromagnet: a transfer-matrix approach
1188 *S F Edwards and A G Goodyear* · The velocity distribution function for a polymer chain
1196 *R Collins and A Wragg* · Density distribution of a confined polymer

Thermodynamics

- 1206** *P G Wright* · Pippard's relations applied to certain λ transitions in dielectric and magnetic materials

Electromagnetism and Electrodynamics

- 1221** *G J Pert* · Inverse bremsstrahlung absorption in large radiation fields during binary collisions—Born approximation I. Elastic collisions

Elementary Particle and Nuclear Physics

- 1233** *M S Stern and A E A Warburton* · S-wave eigenvalues of the Lippmann-Schwinger kernel for the exponential potential
1236 *A K De, P Ghosh, S Mitra, P C Bhattacharya and A K Das* · The muon flux of cosmic rays at sea level
1243 *G Satyanarayana, V V Ramamurty and V Lakshminarayana* · Lifetime of the 321 keV($9/2^-$) state in ^{125}Te
1248 *D K Butt and A R Wilson* · A study of the radioactive decay law
1252 *A M MacLeod and G R Milne* · Proton nuclear reaction cross sections in carbon and the $^{12}\text{C}(p, p^3\alpha)$ reaction mechanism at 13 MeV
1262 *A Lakshmana Rao and J Rama Rao* · Cross sections and isomer ratios for some neutron capture reactions
1266 *R B Heller, I Sugai, Yueh-Li Cheng and L W Chiao* · The beta spectrum of the fission products from ^{252}Cf and the associated inner bremsstrahlung radiation

Optical Properties of Fluids

- 1272** *F Hynne and R K Bullough* · The Onsager reaction field as a screened self-interaction in refractive index theory

Astrophysics

- 1296** *P C W Davies* · Time variation of the coupling constants

NO 9 SEPTEMBER 1972

LETTERS TO THE EDITOR

- L81 *A J Guttman and G S Joyce* · On a new method of series analysis in lattice statistics
 L85 *J D Gibbon* · Motion of a relativistic electron in a spatially modulated magnetic field
 L89 *P B Burt and J L Reid* · Exact solutions to quantized field theories

PAPERS

Mathematical Physics

- 1305 *A Banerjee* · Some properties of a uniform fluid sphere in general relativity
 1312 *R J Henery* · The generalized Langevin equation

Electromagnetism and Electrodynamics

- 1320 *J B Ehrman* · Straggling of moderately relativistic electrons
 1337 *C B Wheeler* · Space charge limited photoelectric emission in a plane parallel electrode geometry

Quantum Electronics and Quantum Optics

- 1355 *J C Eilbeck* · Reflection of short pulses in linear optics

Elementary Particle and Nuclear Physics

- 1364 *D Barkai and K J M Moriarty* · U(6, 6) symmetry and the generalized Veneziano model for $K^- p \rightarrow K^* \pi^+ n$
 1374 *C P Wang and A L L Lin* · Particle production spectra and the internal structure of the hadrons
 1384 *B C Nandi and M S Sinha* · The momentum spectrum of muons at sea level in the range 5–1200 GeV/c
 1395 *T Nagarajan, M Ravindranath and K Venkata Reddy* · Precision analysis of ^{198}Au beta spectral shape
 1404 *A Chisholm and J P Nicholson* · Pair production cross section in lead

Astrophysics

- 1409 *T L Chow* · Propagation of radiative shock waves in an inhomogeneous cosmic medium
 1419 *J Wdowczyk, W Tkaczyk and A W Wolfendale* · Primary cosmic γ rays above 10^{12} eV

NO 10 OCTOBER 1972

LETTERS TO THE EDITOR

- L91 *D P Mason* · Infinite conductivity in general relativistic magnetohydrodynamics
 L93 *E Jakeman, C J Oliver, E R Pike and P N Pusey* · Correlation of scaled photon-counting fluctuations
 L97 *P Raychaudhuri* · The parton model, electromagnetic form factors of hadrons and high energy elastic $\pi^+ p$ scattering
 L102 *C A Ayre, M A Hamdan, C J Hume, B C Nandi, M G Thompson, S C Wells, M R Whalley and A W Wolfendale* · Multiple scattering of cosmic ray muons in the range 10–70 GeV/c
 L106 *A M I A W Durnford* · Uniqueness of ^{56}Fe as a primary standard for atomic masses
 L109 *J C Byrne and R R Burman* · A photon rest mass and magnetic fields in the Galaxy

PAPERS

Mathematical Physics

- 1433 *P T Landsberg and K A Johns* · Carnot efficiencies for moving reservoirs

- 1438 *J Rae* · Zitterbewegung as a subdynamics
 1447 *J Mahanty and B W Ninham* · Dispersion forces between oscillators: a semiclassical treatment

Quantum Electronics and Quantum Optics

- 1453 *B V Thompson* · A variational estimate of the lowest eigenvalue of the multimode, multimode Hamiltonian of quantum optics

Quantum Field Theory

- 1461 *J D Jenkins* · The electromagnetic interaction of a massive spin one particle: some equivalence theorems and remarks
 1473 *B W Keck and J G Taylor* · On the finiteness of nonderivative nonpolynomial Lagrangians

Elementary Particle and Nuclear Physics

- 1479 *P T Davies* · The matrix superpropagator of a chiral invariant pion-nucleon interaction
 1488 *M Novello and P Rotelli* · The cosmological dependence of weak interactions
 1495 *G Purkayastha, N C Sil and S N Banerjee* · Triton binding energy by the Faddeev approach with two-body local interactions
 1502 *Y C Saxena* · High energy muons (> 150 GeV) in extensive air showers
 1514 *J Wdowczyk and E Zujewska* · The possibility of a consistent explanation of various phenomena involving cosmic ray muons
 1524 *H G Price* · Analogue resonances of low lying levels of ^{52}V in the $^{51}\text{V}(p, \gamma)^{52}\text{Cr}$ reaction
 1529 *M E Cage, P D Kunz, R R Johnson and D A Lind* · A study of the $^{113}\text{In}(^3\text{He}, d)^{114}\text{Sn}$ reaction at 37.7 MeV

Fluids

- 1537 *S Simons* · The nonlinear BGK model—a derivation and two applications

NO 11 NOVEMBER 1972

LETTERS TO THE EDITOR

- L113 *D G Maeder* · On a mechanical matching condition related to the detection limit for gravitational radiation
 L119 *B Crosignani, P Di Porto and S Solimeno* · Quantum effects in second harmonic generation
 L122 *J D Gibbon and J C Eilbeck* · A possible N soliton solution for a nonlinear optics equation
 L125 *M W Kermode* · A non-singular, local $^1\text{S}_0$ neutron-proton potential
 L128 *R Burman* · A photon rest mass and energy transport in cold plasmas

PAPERS

Mathematical Physics

- 1545 *D S Chellone* · Newman-Penrose conserved quantities in Born-Infeld electrodynamics
 1550 *G A Maugin* · Remarks on dissipative processes in the continuum theory of micromagnetics
 1563 *W Byers Brown* · Perturbation theory for odd perturbations
 1566 *R Phythian* · A variational method in statistical mechanics
 1573 *S Datta Majumdar* · Note on the parameters and the volume element of $\text{SU}(n)$

Electromagnetism and Electrodynamics

- 1578 *J Askne* · Quantization of waves in dispersive media with application to nonlinear interactions of plasmons

Quantum Electronics and Quantum Optics

- 1587 *S Swain* · An exact analysis of spontaneous emission by a single two level atom in the rotating wave approximation I. Analytic results

- 1601 *S Swain* · An exact analysis of spontaneous emission by a single two level atom in the rotating wave approximation II. Numerical results
 1619 *S H Chen, P Tartaglia and N Polonsky-Ostrowsky* · A method for the clipped intensity correlation measurement

Elementary Particle and Nuclear Physics

- 1624 *F El-Bedewi and M Shalaby* · Study of energy levels of ^{29}Si via deuteron stripping
 1639 *A P S Sirohi and M K Srivastava* · Numerical calculation of the energy eigenvalues for a local potential

Fluids

- 1642 *W Rudziński* · Summation of the virial expansion for the equation of state

NO 12 DECEMBER 1972

LETTERS TO THE EDITOR

- L131 *P A Goodinson* · A note on the gravitational field of a rotating radiating source
 L132 *J D Gibbon and J C Eilbeck* · The asymptotic form of the N soliton solution of the Korteweg-de Vries equation

PAPERS

Mathematical Physics

- 1649 *M J Caola* · The spin hamiltonian
 1658 *H H Nickle and B L Beers* · Algebraic solution of the Klein-Gordon equation
 1664 *R E Trueman and S G Whittington* · Limiting ring closure probability on the square lattice
 1669 *M Ohminami, Y Abe and S Katsura* · Distribution of zeros of the partition function of the antiferromagnetic Husimi-Temperley model
 1680 *D S F Crothers* · Asymptotic expansions for parabolic cylinder functions of large order and argument

Elementary Particle and Nuclear Physics

- 1689 *P H Dondi* · Linearization and symmetry breaking in nonlinear $\text{SU}(3) \times \text{SU}(3)$
 1698 *P T Davies* · A chiral superpropagator for pions
 1706 *C Grupen, M A Hamdan, S Hansen, M G Thompson, A W Wolfendale and E C M Young* · Electromagnetic interactions of cosmic ray muons in iron I. Search for a charge asymmetry
 1713 *C Grupen, M A Hamdan, S Hansen, M G Thompson, A W Wolfendale and E C M Young* · Electromagnetic interactions of cosmic ray muons in iron II. Momentum dependence of the interaction probabilities

Astrophysics

- 1722 *P C W Davies* · Is the universe transparent or opaque?

1738 CORRIGENDUM

1739 SUBJECT INDEX, Vol 5

1750 AUTHOR INDEX (with titles), Vol 5

Subject index

- ABFST model
 - high energy scattering 853-8
- Absorption
 - ^{37}Cl neutrino, experiment L19-23
 - inverse bremsstrahlung 506-15, 1221-32
 - of longitudinal electric waves in interstellar space L78-80
 - Wheeler-Feynman theory of radiation 1722-37
- Air showers
 - muons in 125-31, 1502-13
 - search for massive hadrons in 569-83
- Algebraic solution
 - Klein-Gordon equation 1658-63
- Alkane
 - relative permittivity over range of pressures and temperatures 897-903
- Aluminium
 - lifetimes and decay modes of energy levels 302-17
- Amplified spontaneous emission
 - beam divergence 546-54
 - spectral distribution 695-704
- Analogue resonance
 - in $^{51}\text{V}(p, \gamma)^{52}\text{Cr}$ reaction 1524-8
- Angular distribution
 - cosmic ray muons 292-301
- Angular momentum
 - projection from nonaxial intrinsic states 584-95
 - theory 231-40
- Anisotropy
 - of cosmic rays 904-15
- Antiferromagnetic Husimi-Temperley model
 - distribution of zeros of the partition function of 1669-79
- Asymptotics
 - of chain molecular distribution 85-94
- Asynchronous excitation
 - of a plasma instability L74-7
- Atoms, *see also* Impurity atom
 - complex, electron wavefunction L10-2
 - K shell electron wavefunctions L10-2
 - single two level, in rotating wave approximation 1587-1618
- Atomic mass
 - ^{56}Fe as primary standard L106-8
- Beam divergence
 - in amplified spontaneous emission 546-54
- BGK model
 - for macroscopic variations 1537-44
- Boltzmann quantum equation
 - for electronic relaxation 171-8
- Bonnor's unified field theory
 - nonstatic isolated system L25-7
- Born approximation
 - for inverse bremsstrahlung 1221-32
- Born-Infeld electrodynamics
 - Newman-Penrose conserved quantities 1545-9
- Bounds, *see* Lower bounds
- Brans-Dicke scalar-tensor theory
 - relation to Mach's principle 803-11
- Bremsstrahlung
 - absorption coefficient 506-15, 1221-32
 - as source of straggling 1320-36
 - inverse, approximation 1221-32
 - of ^{232}Cf 1266-71
 - ^{204}Tl 460-7
- Californium
 - beta spectrum of ^{252}Cf fission products 1266-71
- Carbon
 - proton nuclear reaction cross sections in 1252-61
- Carnot efficiency
 - for moving reservoirs 1433-7
- Cascade
 - electromagnetic, theory of longitudinal development 1054-72
 - electron-photon, simulation 859-76
- Chandrasekhar's integral form
 - derivation of Treloar's distribution 78-84
 - polymer distribution density 85-94
- Charge asymmetry
 - search for in electromagnetic interactions of cosmic ray muons 1706-12
- Chiral
 - current as field variable 348-64
 - invariant pion-nucleon interaction 1479-87
 - superpropagator for pions 1698-705
- algebra
 - SU(3), nonlinear realizations on meson fields 563-8
 - SU(3) $\times$ SU(3), canonical second rank tensors 830-7
 - SU(3) $\times$ SU(3), in terms of hermitian octet vector 555-62
- Chlorine
 - neutrino absorption L19-23
- Closure approximation
 - in selfavoiding walk problems 411-6

- Cloud chamber technique
 - hadron simulation 859-76
- Coincidence experiment
 - in e^-e^- and e^+e^- scattering 431-43
- Coleman's theory of gravitation
 - comments L30-1
- Collective motion
 - and single particle model 929-35
- Collision
 - binary, absorption coefficient 506-15
 - neutron-deuteron 1495-501
- Complex atom
 - electron wavefunction L10-2
- Composite model
 - in general relativity 211-30
- Conductivity
 - in general relativistic magnetohydrodynamics L91-2
- Conserved quantity
 - in Born-Infeld electrodynamics 1545-9
- Continuum mechanics
 - in micromagnetics of deformable media 1550-62
- Convolution hypernetted chain theory
 - selfconsistent approximation 499-505
- Cosmic medium
 - shock wave propagation 1409-18
- Cosmic neutrinos
 - weak interactions 1488-94
- Cosmic rays
 - anisotropy 904-15
 - gamma 1419-32
 - nonionizing component 745-62
 - of galactic origin above 10^{11} eV 904-15
 - primary 1419-32
- muons
 - at sea level 1236-42, 1384-94
 - electromagnetic interactions 1706-12, 1713-21
 - consistent explanation 1514-23
 - in the range 10-70 GeV/c L102-5
 - in the range 10-300 GeV/c, improved measurement of charge ratio L53-6
 - in the range 50-70 GeV 292-301
- Cosmological dependence
 - weak interactions 1488-94
- Cosmology
 - hot big bang, neutrino processes in the lepton era L17-8
 - opaque universe 1722-37
 - transparent universe 1722-37
- Coupling constants
 - time variation 1296-1304
- Crystal lattice, *see* Lattice
- Curie point
 - of ferromagnets 1206-20
- Cyclotron resonance spectrometer-detector
 - quantum mechanical description 263-71
- Damped oscillation
 - analysis 248-55
- Decay
 - of aluminium 302-17
 - of magnesium 302-17
 - of radon 1248-51
 - of silicon 596-604
 - of sodium 302-17
- Deep inelastic region
 - recent experiments 1-26
- Density
 - autocorrelation function of a fluid in equilibrium 1566-72
 - distribution of a confined polymer 1196-1205
- Detection limit
 - for gravitational radiation L113-8
- Detour transitions
 - in 18 spectrum of ^{204}Tl 460-7
- Deuteron stripping
 - energy levels of ^{29}Si 1624-38
- Dielectric liquids
 - in stationary fields, climbing up electrodes 318-26
- Dielectric materials
 - Pippard's relations 1206-20
- Dielectrophoretic force
 - quantitative assessment 318-26
- Diffraction theory
 - Kirchhoff 272-91
- Diffusion
 - time dependence, of single point in molecular chain L15-7
- Dirac field
 - interacting with a massive spin one particle 705-16
- Dissipative process
 - in micromagnetics 1550-62
- Dispersion
 - at resonance, quantum theory 401-10
 - force between oscillators 1447-52
- Dissipation processes
 - in continuum theory of micromagnetics 1550-62
- Distribution function
 - in virial and hypervirial theory 1138-51
 - of a polymer 1188-95
- Drift waves
 - in an rf collisional plasma 1095-1107
- Dynamics
 - of polymer molecule 965-80
- Echo
 - surface form deduction from diffracted echoes 272-91
- Eigenvalue
 - lower bound 1123-30
 - numerical calculation for local potential 1639-41

- Lippmann-Schwinger kernel 112-29
 Elastic electron scattering
 nuclear charge distributions L39-42
 Electromagnetic cascade
 theory of longitudinal development 1054-72
 Electromagnetic interaction
 for spin one 1461-72
 vector mesons with same quantum numbers as the photon 327-47
 theory, nonlinear 1545-9
 Electron
 interaction with microwave electric field 516-23
 microscope image formation 916
 pair production by photons in lead 1404-8
 storage ring 179-97
 stream electrostatic self-focusing 524-33
 wavefunctions in complex atoms L10-2
 collisions
 with atoms 506-15
 with electrons 506-15
 scattering
 elastic L39-42, 506-15
 with electrons, theory of radiative corrections 431-43
 Electroproduction
 deep inelastic region, recent experiments 1-26
 resonance region, recent experiments 1-26
 Electrostatic self-focusing
 electron streams 524-33
 Energy
 eigenvalues for local potential 1639-41
 extremal properties for rotating star 781-5
 levels
 of ^{26}Al 302-17
 of ^{26}Mg 302-17
 of ^{23}Na 302-17
 of ^{29}Si 596-604, 1624-38
 Equation of state
 summation of virial expansion 1642-8
 Equivalence theorem
 for spin one 1037-42
 Euler transform
 for analytic continuation of hypergeometric functions 256-62
 Excitation
 of a plasma L74-7
 energy
 of ^{30}P between 3.7 and 4.7 MeV 454-9
 energy
 of ^{34}S from 5.4 MeV to 7.3 MeV 1073-89
 pattern
 of highly stripped ions 917-28
 Expansion
 asymptotic, for parabolic cylinder functions 1680-8
 External radiation field
 interacting with atom, alters value of Lamb shift 417-25
 Faddeev equation
 for the neutron-deuteron collision problem 1495-1501
 Fermion
 soluble one dimensional model 612-23
 Field
 magnetic, in galaxy L109-11
 variable, chiral current 348-64
 theory
 Bonnor L25-7
 quantum L88-90, 936-43, 1037-42
 unified 394-400
 Finiteness
 nonderivative nonpolynomial Lagrangians 1473-8
 Fluid, *see also* Static perfect fluid
 sphere in general relativity, properties 1305-11
 Fluorescence
 pulse from supernovae 773-80
 Galaxy
 magnetic fields L109-11
 Gamma rays
 cosmic 1419-32
 from supernovae 773-80
 Gaussian process
 Langevin equation 1312-9
 General relativity
 fluid sphere 211-30, 1305-11
 Kerr space-time 605-7
 model 211-30
 static fluid 374-93
 Gold
 ^{198}Au beta spectral shape precision analysis 1395-1403
 Gravitation
 Coleman's theory, similarity to Papapetrou's theory L30-1
 Lorentz-covariant theories L28-9
 Papapetrou's theory L28-9
 Gravitational collapse
 with escaping neutrinos 479-88
 Gravitational field
 of rotating radiating source L131
 Gravitational radiation
 detection limit L113-8
 loss of mass 198-210
 Green function
 lattice 67-77, L65-8
 two-particle 950-69
 Ground state
 energy of many-particle system 608-11

- rotational band in ^{150}Sm and ^{152}Sm L69-73
- Group algebras and tensor operators 1131-7
- Gürsey matrix
 - general form of the $\text{SU}(3)$ 555-62
- Hadrons
 - cascade simulation 859-76
 - electromagnetic form factor L97-101
 - in air shower 569-83
 - interactions, investigated by electron storage rings 179-97
 - internal structure 1374-83
 - phenomenology of multiparticle interactions 27-66
- Hadron physics
 - chiral lagrangian theory 555-62
- Hamiltonian
 - of quantum optics L3-6
 - spin 1649-57
- Harmonic forcing oscillation
 - nonlinear plasma instability effects 152-65
- Harmonic lattice
 - motion of an impurity atom in 365-73
- Harmonic oscillator wavefunction product
 - expansion of 241-5
- Heterodyne detection
 - effect on statistical accuracy of optical linewidth measurement L49-52
- High energy interactions
 - with multilayer cloud chamber 859-76
- High temperature susceptibility
 - of Ising model 624-39, 640-52
- Higher spin production
 - application of a Veneziano model 726-35
- Homogeneous spaces
 - quantum mechanics 936-43
- Humisi-Temperley model
 - antiferromagnetic 1669-79
- Hydrodynamics
 - relativistic L1-3
- Hyperfine interactions
 - of nuclei in ionized atoms 917-28
- Hypergeometric functions
 - analytic continuation by complex single loop Euler transforms 256-62
- Hypervirial theorem
 - distribution functions 1138-51
- Image formation
 - in electron microscope 916
- Impurity atom
 - in a harmonic lattice 365-73
- Inhomogeneous cosmic medium
 - propagation of radiative shock waves in 1409-18
- Inner bremsstrahlung radiation
 - from single spontaneous fission of ^{252}Cf 1266-71
- Instability
 - plasma L43-7, L74-7, 152-65
- Intensity correlation
 - measurement of clipped, 1619-23
- Internal bremsstrahlung spectrum
 - contribution of detour transition 460-7
- Interstellar space
 - wave absorption L78-80
- Interaction probability
 - momentum dependence of electromagnetic interactions of cosmic ray muons 1713
- Intrinsic states
 - angular momentum projection 584-95
- Inverse bremsstrahlung
 - absorption coefficient in binary collisions 506-15, 1221-32
- Ion flow
 - in low pressure plasma 1119-22
- Ionized atoms
 - hyperfine interactions 917-28
- Iron
 - ^{56}Fe standard for atomic masses L106-8
- Ising model
 - one dimensional, partition function, distribution of zeros 95-103
 - selfavoiding rings on a lattice 661-6
 - three dimensional lattices 640-52, 653-60, 667-73
 - two dimensional lattices 624-39, 653-60
- Isomer ratios
 - for neutron capture reactions 1262-5
- Kepler problem
 - with magnetic charges 944-9
- Kerr space-time
 - in general relativity 605-7
- Kirchhoff diffraction theory
 - the form of surfaces from their diffracted echoes 272-91
- Klein-Gordon equation
 - algebraic solution 1658-63
- Lagrangians
 - chiral invariant 1479-87
 - nonderivative nonpolynomial, finiteness 1473-8
- Lamb shift
 - effect of external field 417-25
- Langevin equation
 - markovian and gaussian processes 1312-9

- Lattice**
 harmonic, impurity atom 365-73
 statistics series analysis L81-4
 tadpoles weakly embeddable in 1664-8
 three dimensional, high temperature susceptibility 640-52
 two and three dimensional, selfavoiding walks and returns 653-60
 two dimensional, high temperature susceptibility 624-39
- Green function**
 analytic properties 67-77
 for the simple cubic lattice L65-8
 selfavoiding
 rings 661-6
 walks L60-1, 653-60.
- Lepton era**
 neutrino processes in L17-8
- Lifetime measurement**
 of ^{26}Al 302-17
 of ^{26}Mg 302-17
 of ^{23}Na 302-17
 of ^{30}P 454-9
 of ^{29}Si 596-604
 of ^{125}Te 1243-7
- Light scattering experiment**
 optical mixing in a magnetized plasma 132-45
- Limiting ring closure probability**
 on square lattice 1664-8
- Linear mappings**
 within group algebra 1131-7
- Linear optics reflection**
 theory 1355-63
- Linearization and symmetry breaking**
 in nonlinear $\text{SU}(3) \times \text{SU}(3)$ 1689-97
- Linewidth measurement**
 heterodyne detection L49-52
- Lippmann-Schwinger equation**
 solution 426-30
- Lippmann-Schwinger kernel**
 method for numerical determination of bound states and eigenvalues 112-24
- Liquids, see also Dielectric liquids**
 simple, calculation of surface tension 166-70
- Local potential**
 numerical calculation of energy eigenvalues for 1639-41
- Longitudinal development**
 of electromagnetic cascades 1054-72
- Longitudinal electric waves**
 in interstellar space L62-3
- Lorentz-covariant theory of gravitation**
 deduced from general relativity L28-9
 similarity to a special case of Papapetrou's theories L30-1
- Lorentz spectral line**
 pulse separation measurement L7-10
- Lorentz spectrum**
 two-time generating function 104-11
- Lower bounds**
 for eigenvalues 1123-30
 in many-particle system 608-11
- Mach's principle**
 relationship with Brans-Dicke scalar-tensor theory of gravitation 803-11
- Macromolecules**
 diffusion, mechanical simulation L15-7
 dynamics 965-80
- Macroscopic parameters**
 temporal and spatial variation 1537-44
- Magnesium**
 ^{26}Mg lifetimes and decay modes of energy levels 302-17
 ^{24}Mg and ^{25}Mg nuclear charge distribution L39-42
- Magnetic charges**
 relativistic Kepler problem with magnetic charges, quaternionic solutions 944-9
- Magnetic field**
 in galaxy L109-11
 spatially modulated, motion of a relativistic electron in L85-7
- Magnetic materials**
 Pippard's relations 1206-20
- Magnetized plasma**
 optical mixing 132-45
- Magnetoelastic interactions**
 relativistic theory 786-802
- Magnetohydrodynamics**
 relativistic, barometric formula L1-3
 conductivity L91-2
- Many-particle system**
 lower bound methods 608-11
- Mapping methods**
 for certain simple Riemann surfaces 981-1003
- Mapping, linear**
 within group algebra 1131-7
- Markovian process**
 Langevin equation 1312-9
- Mass loss**
 of a rotating rod 198-210
- Matching condition**
 related to detection limit for gravitational radiation L113-8
- Matrix constructions**
 from generic $\text{SU}(n)$ vector 1043-53
- Mechanics, statistical**
 variational method 1566-72
- Meson field**
 nonlinear realization 563-8
- Mesons, pseudoscalar**
 linear representation 1689-97

- Micromagnetics
 - dissipative process 1550-62
- Microwaves
 - interaction with free electrons 516-23
- Molecular distribution
 - Treloar's distribution 78-84
 - asymptotic behaviour 85-94
- Momentum spectrum
 - of muons at sea level 1384-94
- Monopole
 - in unified field theory 394-400
- Motion
 - impurity atom in harmonic lattice 365-73
- Multiplate cloud chamber
 - Monte Carlo simulation of hadron and electron-photon cascades 859-76
- Multiply connected spaces
 - quantum theory 936-43
- Muons, *see also* Cosmic ray muons
 - close grouping at large distances from cores of extensive air showers 125-31
 - flux of cosmic rays at sea level 1236-42, 1384-94
 - high-energy, in air showers 1502-13
 - range fluctuation 444-53
 - spectrum 1514-23
 - spectrum parameters 292-301
- Néel point
 - use of Pippard's relations 1206-20
- Neutrino process
 - in the lepton era L17-8
- Neutrinos
 - cosmic 1488-94
 - escaping, gravitational collapse 479-88
 - solar, ^{37}Cl absorption experiment L19-23
- Neutron
 - cross section of ^{31}P 1090-4
 - deuteron collision, Faddeev equation 1495-501
 - polarization from the $\text{D(d, n)}^3\text{He}$ reaction L13-4
 - capture
 - cross section at 25 keV 468-70
 - in medium and heavy weight nuclei 877-80
 - reaction cross sections and isomer ratios 1262-5
- Newman-Penrose conserved quantities
 - in Born-Infeld electrodynamics 1545-9
- Noise analysis
 - cyclotron resonance spectrometer-detector 263-71
- Nonderivative nonpolynomial Lagrangians
 - finiteness 1473-8
- Nonionizing cosmic radiation
 - underground 745-62
- Nonlinear BGK model
 - for macroscopic variation 1537-44
- Nonlinear interaction
 - of plasmons 1578-86
- Nonlinear optics
 - equation L122-4
 - quantum mechanical prediction 534-45
 - resonant or nonresonant, method of characteristics 820-9
- Nonlinear plasma
 - instability effect 152-65
- Nonlinear transformation of pseudoscalar mesons
 - for group $\text{SU}(3) \times \text{SU}(3)$ 1689-97
- Nonlinear wave interaction in plasma 881-96
- Nonstatic isolated system
 - Bonner's unified field theory L25-7
- Nuclear charge distributions
 - isotopes from elastic electron scattering L39-42
- Nuclear decay law
 - for radon 1248-51
- Nuclear stability
 - time variation of coupling constants 1294-1304
- Nuclear three-body problem
 - spin-dependent effects L33-7
- Octet vector
 - hermitian 555-62
- Off-shell partial-wave
 - Lippmann-Schwinger equation 426-30
- One dimensional
 - Ising models 95-103
 - of a ferromagnet, phase transitions 1176-87
- Onsager reaction field
 - as a screened self-interaction in refractive index theory 1272-95
- Optical linewidth measurements
 - statistical accuracy achieved by heterodyne detection L49-52
- Optical mixing
 - in a magnetized plasma 132-45
- Optics
 - linear, reflection of short pulses 1355-63
 - nonlinear
 - equation L122-4, L132-5
 - methods of characteristics 820-9
 - quantum effects in 534-45
- Orbits
 - $\text{SU}(3)$ in E_8 563-8
- Oscillation
 - damped, analysis 248-55
- Oscillator
 - dispersion forces 1447-52
- p wave neutron capture
 - in medium and heavy nuclei 877-80

- Pair production
 - cross-section in lead 1404-8
- Papapetrou's theory of gravitation
 - similarity of Coleman's theory L28-9
- Parabolic cylinder function
 - asymptotic expansions for 1680-8
- Parametrization
 - and volume element of $SU(n)$ 1573-7
- Parastochastics
 - and quantum mechanics 495-8
- Partial-wave scattering
 - amplitudes and conformal mapping methods 981-1003
- Partial-wave Schrödinger equation
 - finite difference solution 112-24
- Particle model, single
 - connection with collective motion 929-35
- Particle production spectra
 - and the internal structure of hadrons 1374-83
- Partition function
 - for the antiferromagnets 1669-79
- Parton model
 - differential cross section for π^+p elastic scattering L97-101
- Path integration
 - three body problem L57-9, 812-9
- Percus-Yevick theory
 - self-consistent approximation 499-505
- Permittivity
 - organic liquids 897-903
- Perturbation
 - expansion of wavefunction 401-10
 - theory
 - for odd perturbations 1563-5
 - for stationary homogeneous turbulence 246-7
- Phase integral analysis
 - of double underdense potential-barrier problems 1680-8
- Phase transitions
 - in one dimensional model of a ferromagnet 1176-87
- Phosphorus
 - ^{31}P neutron total cross section 1090-4
- Photocount statistics
 - of gaussian light 682-94
- Photoelectric emission
 - in plane parallel electrode geometry 1337-54
- Photoelectrons
 - correlation devices L7-10
- Photon
 - correlation measurement 104-11
 - counting fluctuations, digital correlation L93-6
 - energy spectrum 1419-32
 - neutrino coupling theory L17-8
 - rest mass L78-80, L109-11
 - scattering in lead 1404-8
- Pion-nucleon interaction
 - superpropagator 1479-87, 1698-705
- Pion-nucleon scattering
 - multiple scattering model 838-52
- Pions
 - longitudinal momentum distribution 1374-83
- Pippard's relations
 - for λ transitions, Curie and Néel points 1004-14
 - for λ transitions, solutions of ^3He in liquid ^4He 1018-24
 - in dielectric and magnetic materials 1206-20
- Plane-parallel electrode geometry
 - space charge limited photoelectric emission in 1337-54
- Plane-wave radiation field
 - interaction of charged particle 1658-63
- Plasma
 - absorption 506-15, L78-80
 - cold, absorption of longitudinal electric waves L78-80
 - hot, surface waves 1108-1118
 - low pressure, supersonic ion flow 119-22
 - magnetized, optical mixing 132-45
 - nonlinear, instability effects 152-65
 - RF collisional, low frequency selfexcited oscillation 1095-1107
 - resonant excitation of ion plasma waves by VLF and whistler waves 146-51
 - solid state, temperature gradient-induced instability L43-7
 - wave interactions 881-96
 - wave propagation 471-8, L62-3
 - instability
 - asynchronous excitation L74-7
 - harmonic forcing oscillation 152-65
 - temperature gradient induced L43-7
- Plasmons
 - nonlinear interactions 1578-86
- Polymer
 - chain, velocity distribution function 1188-95
 - confined, density distribution 1196-1205
 - model of entanglement 674-81
 - molecules, dynamics 965-80
- Positron-electron scattering
 - theory of radiative corrections 431-43
- Potential
 - local, $^1S_0$ neutron-proton L125-7
- Primary cosmic γ rays
 - above 10^{12} eV 1419-32
- Proca field
 - interaction with arbitrary field 1037-42
- Proton nuclear reaction
 - cross section in carbon 1252-61

- Pseudoscalar meson
transformation 1689-97
- Pulse separation measurement
for photoelectrons L7-10
- Quantum effect
in second harmonic generation L119-21
- Quantum electrodynamics
investigated by electron storage rings
179-97
- Quantum field theory
one dimensional L88-90
on multiply connected and homogeneous
spaces 936-43
- Quantum mechanics
and field theory on multiply connected
spaces 936-43
interpolation theory 489-94
solution to dynamical problems by path
integral formulation of Feynman 812-9
spin hamiltonian for g fold degenerate
level 1549-57
used in classified parastochastics 495-8
- Quantum optics
solution of multiatom, multimode model
Hamiltonian L3-6
theory, resonance dispersion 401-10
- Quantum theory
variational trial function 1152-64,
1165-75
- Quaternionic solutions
for relativistic Kepler problem 944-9
- Radiation
charged particle interacting with classical
plane-wave radiation field 1658-63
field, external, Lamb shift 417-25
gravitational, detection limit L113-8
gravitational, loss of mass 198-210
inner bremsstrahlung from single
spontaneous fission of ^{252}Cf 1266-7
Wheeler-Feynman theory 1722-37
- Radiative corrections
for e^+e^- and $e^+e^-e^-$ scattering 431-43
- Radiative shock waves
in an inhomogeneous cosmic medium
1409-18
- Radioactive decay law
for radon 1248-51
- Radon
decay 1248-51
- Range fluctuations
high energy muons 444-53
- Rao's rule
and Wada's relation L31-2, L37-8
- Reaction field, Onsager
in refractive index theory 1272-95
- Recurrence relation method
of series analysis in lattice statistics
L81-4
- Reflection
of short pulses in linear optics 1355-63
- Refractive index
Böttcher formula 1272-95
- Regge poles
high-energy 726-35
in potential scattering, numerical
determination 717-25
- Relativistic electron
in a spatially modulated magnetic field
L85-7
straggling 1320-30
- Relativistic magnetohydrodynamics
infinite conductivity L91-2
- Relativistic theory
magnetoelastic interactions 786-802
- Relativity, general,
fluid sphere 211-30, 1305-11
Kerr space-time 605-7
model 211-30
static fluid 374-93
- Relaxation
electronic, resolving quantum equation
171-8
- Reservoirs
Carnot efficiency 1433-7
- Resonance
analogue in $^{51}\text{V}(p, \gamma)$ ^{52}Cr reaction
1524-8
dispersion curves in the neighbourhood
of 401-10
region experiment 1-26
spectrometer-detector 263-71
- Rod, rotating
loss of gravitational mass as outgoing
gravitational radiation 198-210
- Rotating wave approximation
spontaneous emission by single two level
atom 1587-1618
- Samarium
rotational band in ^{150}Sm and ^{151}Sm
L69-73
- Scalar-tensor theory
relation with Mach's principle
803-11
- Scaled photon-counting fluctuation
correlation L93-6
- Scattering
high energy, ABFST model 853-8
high energy elastic L97-101
inelastic, as source of straggling 1320-36
KN and KN charge-exchange,
application of Veneziano model
736-44

- multiple scattering model for
 - pion-nucleon scattering 838-52
- of cosmic ray muons in the range
 - 10-70 GeV/c L102-5
- of photons in lead 1404-8
- partial wave 981-1003
- Regge poles 717-25, 726-35
- Schrödinger equation
 - perturbed 1563-5
 - finite difference solution 112-24
- Screened self-interaction
 - in refractive index theory 1272-95
- Second harmonic generation
 - quantum effects L119-21
- Second rank tensor
 - for chiral $SU(3) \times SU(3)$ 830-7
- Selfavoiding rings
 - on a lattice 661-6
- Selfavoiding walks
 - asymptotic behaviour 653-60
 - numerical investigation of closure
 - approximations 411-6
 - on a crystal lattice L60-1
- Selfconsistent approximation
 - for the PY2 and CHNC2 theories for
 - the evaluation of viral coefficients
 - 499-505
- Self-energy expansion
 - two-particle Green function 950-64
- Shock propagation
 - in an inhomogeneous cosmic medium
 - 1409-18
- Silicon
 - deuteron stripping of ^{29}Si 1624-38
 - principle decay modes and lifetimes of
 - energy levels in ^{29}Si 596-604
- Silicone fluid
 - detectable three photon yield 763-6
- Simple cube lattice
 - lattice Green function for L65-8
- Simulation
 - of diffusion of long macromolecules
 - L15-7
 - of hadron in cloud chamber 859-76
- Single particle
 - and collective motion 929-35
- Sodium
 - lifetimes and decay modes of energy
 - levels in ^{23}Na 302-17
- Solar neutrinos
 - ^{37}Cl absorption experiment L19-23
- Solid state plasma
 - instability L43-7
- Space charge limited photoelectric emission
 - in a plane parallel electrode geometry
 - 1337-54
- Spatial coherence
 - on photon correlation measurements
 - 104-11
- Specific heat
 - high temperature series expansions of
 - Ising model of ferromagnet 667-73
- Spectra
 - asymmetric 1374-83
 - continuous, variational trial functions
 - 1165-75
 - discrete, variational trial function
 - 1152-64
- Spectral distribution
 - of amplified spontaneous emission
 - 695-704
- Spectral profile
 - arbitrary 682-94
- Spherical gravitational collapse
 - with escaping neutrinos 479-88
- Spin assignments
 - for higher excited states in ^{34}S 1073-89
- Spin-dependent effects
 - in three body final state from $^3\text{H}(d, n)\text{pd}$
 - reaction at 11.3 MeV incident deuteron
 - energy L33-7
- Spin hamiltonian
 - for g fold degenerate level of a system
 - 1649-57
- Spin-lattice relaxation
 - method of resolving Boltzmann quantum
 - equation 171-8
- Spin one formalism
 - electromagnetic interaction 1461-72
- Spin one particle
 - electromagnetic interaction 1461-72
 - equivalence theorem 705-16
 - field, quantization 1037-42
- Spin states
 - ^{150}Sm and ^{152}Sm L69-73
- Spin theory
 - spherical top model 231-40
- Spontaneous emission
 - amplified 546-54, 695-704
 - by single two level atom in rotating wave
 - approximation 1587-1618
- Square lattice
 - Ising model 624-39
 - selfavoiding rings 661-6
- Star, rotating
 - energy properties 781-5
- Static fluid
 - in general relativity 374-93
- Static fluid spheres
 - stability, investigated on the basis of
 - general relativity 211-30
- Stationary homogeneous turbulence
 - perturbation theory 246-7
- Statistical mechanics
 - variational method 1566-72
- Stevenson bound
 - in relation to Temple and Weinstein
 - bounds 1123-30

- Storage rings
electron 179-97
- Straggling
of moderately relativistic electrons 1320-36
- Subdynamics
Zitterbewegung 1438-46
- Subharmonic forcing oscillations
nonlinear plasma instability effects 152-65
- Submillimetre-wave solution measurements
of *p*-difluorobenzene in nonpolar solvents 767-72
- Sulphur
spin assignment in ^{34}S 1073-89
- Summation of virial expansion
for equation of state 1642-8
- SU(*n*)
algebra 555-62, 563-8
tensor 830-7
vector, tensor construction 1043-53
volume element 1573-7
- Supernovae
fluorescence pulse from 773-80
- Supersonic ion flow
in plasmas 1119-22
- Surface forms
deduced from their diffracted echoes 272-91
- Surface tension
of simple liquids 166-70
wave in hot plasma 1108-18
- Symmetry
for $\text{K}^- \text{p} \rightarrow \text{K}^0 \pi^+ \text{n}$ 1364-73
- Symmetry breaking
in nonlinear $\text{SU}(3) \times \text{SU}(3)$ 1689-97
- Tadpoles
weakly embeddable in a given lattice 1664-8
- Tellurium
lifetime of the 321 keV ($9/2^-$) state in ^{125}Te 1243-7
- Temple bound
in relation to Weinstein and Stevenson bounds 1123-30
- Tensor construction
from generic SU(*n*) vector 1043-53
- Tensor operators
and group algebras 1131-7
- Tensors
canonical second rank for $\text{SU}(3) \times \text{SU}(3)$ 830-7
- Thallium
bremsstrahlung spectrum of ^{204}Tl 460-7
- Thermionic emission
in plane parallel electrode geometry 1337-54
- Thermodynamic relations
for λ transitions in mixtures 1004-14, 1018-24
- Three-body problem
path integration L57-9, 812-9
spin-dependent effect L33-7
- Three quantum annihilations
in silicone fluids 763-6
- Time variation
coupling constants 1296-1304
- Tin
study of the $^{113}\text{In}(^3\text{He}, \text{d})^{114}\text{Sn}$ reaction at 37.7 MeV 1529-36
- Transfer matrix
for ferromagnetic version of a one dimensional model 1176-87
- Treloar's distribution
numerical implementation 78-84
- Triton binding energy
by Faddeev approach with two-body local interactions 1495-1501
- Turbulence, homogeneous
perturbation theory 246-7
- Two-body local interactions
triton binding energy 1495-1501
- Two-particle Green function
self-energy expansion 950-64
- Two-particle wave function
expansion of 241-5
- Unified field theories
nonexistence of isolated charged monopoles 394-400
- Uniform fluid spheres
in a general relativity 1305-11
- Universe
transparent or opaque? 1722-37
- Vanadium
analogue resonance in $^{51}\text{V}(\text{p}, \gamma)^{52}\text{Cr}$ reaction 1524-8
- Variational method
in statistical mechanics 1566-72
- Variational trial function
in quantum theory 1152-64, 1165-75
- Vector
generic SU(*n*), matrix and tensor constructions 1043-53
hermitian octet 555-62
mesons 327-47
tetrad structure 348-64
- Velocity distribution function
for a polymer chain 1188-95
- Veneziano model
for higher spin production 726-35
for KN and $\bar{\text{K}}\text{N}$ charge-exchange scattering 736-44
for $\text{K}^- \text{p} \rightarrow \text{K}^0 \pi^+ \text{n}$ 1364-73

- Virial expansion
 of equation of state 1642-8
- Virial theory
 distribution functions 1138-51
- VLF waves
 resonant excitation of ion plasma waves 146-51
- Wada, *see* Rao's rule
- Wave absorption
 in interstellar space L78-80
- Wave approximation
 spontaneous emission by single two level atom 1587-1618
- Wavefunctions
 perturbation expansion 401-10
 two particle 241-5
- Wave propagation
 in a two-component warm plasma 471-8, L62-3
- Waves
 longitudinal electric waves in cold plasmas, absorption L28-80
 quantized, in dispersive media 1578-86
- surface, in hot plasma 1108-18
- VLF and Whistler, resonant excitation of ion plasma waves 146-51
- Weinstein bound
 in relation to Temple and Stevenson bounds 1123-30
- Wheeler-Feynman
 absorber theory of radiation 1722-37
 quantum theory 1025-36
- Whistler waves
 resonant excitation of ion plasma waves 146-51
- X rays
 from supernovae 773-80
- Zeros, distribution of
 in partition function for the antiferromagnets 1669-79
 of partition function for one dimensional Ising models 95-103
- Zitterbewegung
 as a subdynamics 1438-46

Author index with titles

- Abe Y: *see* Ohniami M 1669
- Adjei S A, Collins P A, Hartley B J, Moore R W and Moriarty K J M: a Veneziano model with cuts for $\overline{K}N$ and $\overline{K}N$ charge-exchange scattering 736
- Alcock M W: *see* Keen B E 1095
- Alderson P R: *see* Durell J L 302
- Alexander-Katz R and Edwards S F: the statistical mechanics of entangled polymers 674
- Allen L and Peters G I: spectral distribution of amplified spontaneous emission 695
- Allen L: *see* Peters G I 546
- Askne J: quantization of waves in dispersive media with application to nonlinear interactions of plasmons 1578
- Ayre C A, Hamdan M A, Hume C J, Nandi B C, Thompson M G, Wells S C, Whalley M R and Wolfendale A W: multiple scattering of cosmic ray muons in the range 10-70 GeV/c L102
- Ayre C A, Hume C J, Nandi B C, Thompson M G, Wells S C, Whalley M R and Wolfendale A W: an improved measurement of the charge ratio of cosmic ray muons in the range 10-300 GeV/c L53
- Bailey D C, Carr P E, Durell J L, Green L L, Greene M W, James A N, Sharpey-Schafer J F and Viggars D A: a study of the principal decay modes and lifetimes of levels in ^{29}Si below 7.2 MeV 596
- Bailey D C: *see* Durell J L 302
- Bailey D C: *see* Nolan P J 454
- Bandyopadhyay P: solar neutrinos and the ^{37}Cl neutrino absorption experiment L19
- Banerjee A: some properties of a uniform fluid sphere in general relativity 1305
- Banerjee S N: *see* Purkayastha G 1495
- Barkai D and Moriarty K J M: $U(6,6)$ symmetry and the generalized Veneziano model for $K^*p \rightarrow K^*n$ 1364
- Barnes A: static perfect fluids in general relativity 374
- Barnes K J: canonical second rank tensors for chiral $\text{SU}(3) \times \text{SU}(3)$ 830
- Barnes K J and Delbourgo R: matrix and tensor constructions from a generic $\text{SU}(n)$ vector 1043
- Barnes K J, Dondi P H and Sarkar S C: general form of the $\text{SU}(3)$ Gürsey matrix 555
- Barr H and Boyd T J M: surface waves in hot plasmas 1108
- Barton J C and Pourgourides C M: a study of the nonionizing component of the cosmic radiation underground 745
- Basano L: a note on Lorentz-covariant theories of gravitation L28
- Beers B L: *see* Nickle H H 1658
- Bennett W H: *see* McCorkle R A 524
- Berry M V: on deducing the form of surfaces from their diffracted echoes 272
- Berry M V, Durrans R F and Evans R: the calculation of surface tension for simple liquids 166
- Bhatnagar T N: *see* Sharma S R 471
- Bhattacharya P C: *see* De A K 1236
- Blake J G: *see* Kelly H C L7
- Blake P R, Ferguson H and Nash W F: muon bundles in large BaS 125
- Blyth C O: *see* Dunscombe P B L13
- Blyth C O: *see* Pope C L33
- Borgia B: results from storage rings 179
- Bourret R: classical parastochastics and quantum mechanics: some observations 495
- Boyd T J M, Newton R H C and Woodison P M: temperature gradient-induced instability in a solid state plasma L43
- Boyd T J M and Turner J G: optical mixing in a magnetized plasma 132
- Boyd T J M and Turner J G: lagrangian studies of plasma wave interactions I 881
- Boyd T J M: *see* Barr H C 1108
- Brain S W: *see* Curran C S L39
- Brasse F W: electroproduction experiments 1
- Buget N: *see* Pope C L33
- Bullough R K: *see* Eilbeck J C 820
- Bullough R K: *see* Hynne F 1272
- Burman R: a photon rest mass and the dispersion of longitudinal electric waves in interstellar space L62
- Burman R: a photon rest mass and the absorption of longitudinal electric waves in interstellar space L78
- Burman R: a photon rest mass and energy transport in cold plasmas L128
- Burman R: *see* Byrne J C L109
- Burt P B and Reid J L: exact solutions to quantized field theories L89
- Butt D K and Wilson A R: a study of the radioactive decay law 1248
- Byers Brown W: perturbation theory for odd perturbations 1563
- Byrne J C and Burman R: a photon rest mass and magnetic fields in the Galaxy L109
- Cage M E, Kunz P D, Johnson R R and Lind D A: a study of the $^{113}\text{In}(^3\text{He},d)^{114}\text{Sn}$ reaction at 37.7 MeV 1529
- Caola M J: the spin hamiltonian 1649

- Carmi G *see* Witteles E M 612
 Carr P E: *see* Bailey D C 596
 Carr P E: *see* Nolan P J 454
 Chamberlain J: *see* Davies G J 767
 Chapman R: *see* Hartley A J L69
 Charap J M and Davies P T: parametrization of SU(3) orbits in E_8 563
 Charman W N and Jelley J V: a search for pulses of fluorescence produced by supernovae in the upper atmosphere 773
 Chellone D S: Newman-Penrose conserved quantities in Born-Infeld electrodynamics 1545
 Chen S H, Tantiaglia P and Polonsky-Ostrowsky: a method for the clipped intensity correlation measurement 1619
 Chiao L W: *see* Heller R B 1266
 Chisholm A and Nicholson J P: pair production cross section in lead 1404
 Choudhary A R and Jones R B: analyticity of partial wave scattering amplitudes and conformal mapping methods 981
 Chow T L: propagation of radiative shock waves in an inhomogeneous cosmic medium 1409
 Ciubotariu C: a barometric formula in relativistic magnetohydrodynamics L1
 Collins P A, Hartley B J, Moore R W, Moriarty K J M and Parry G W: a Veneziano model, with absorptive corrections, for higher spin production 726
 Collins P A: *see* Adjei S A 736
 Collins R and Wragg A: density distribution of a confined polymer 1196
 Crawford G I: *see* Kellie J D 1090
 Crosignani B, Di Porto P and Solimeno S: quantum effects in second harmonic generation L119
 Crothers D S F: analytic continuation of hypergeometric functions by complex single loop Euler transforms 256
 Crothers D S F: asymptotic expansions for parabolic cylinder functions of large order and argument 1680
 Crubellier A: *see* Feneuille S 944
 Curran C S, Drake T E, Johnston A, Brain S W, Gillespie W A, Lees E W, Singhal R P and Slight A G: nuclear charge distributions of the isotopes ^{24}Mg , ^{25}Mg and ^{26}Mg from elastic electron scattering L39
 Daba D: the interpretation of the effect of climbing up electrodes of the dielectric liquids in stationary fields (the Sumoto effect) 318
 Das A K: *see* De A K 1236
 Dass N: *see* Singh O L37
 Datta Majumdar S: note on the parameters and the volume element of SU(n) 1573
 Davies G J and Chamberlain J: high accuracy submillimetre-wave solution measurements 767
 Davies P C W: extension of Wheeler-Feynman quantum theory to the relativistic domain II. Emission processes 1025
 Davies P C W: time variation of the coupling constants 1296
 Davies P C W: is the universe transparent or opaque? 1722
 Davies P T: the matrix superpropagator of a chiral invariant pion-nucleon interaction 1479
 Davies P T: a chiral superpropagator for pions 1698
 Davies P T: *see* Charap J M 563
 De A K, Ghosh P, Mitra S, Bhattacharya P C and Das A K: the muon flux of cosmic rays at sea level 1236
 Delbourgo R: *see* Barnes K J 1043
 Delves L M: on the Temple lower bound for eigenvalues 1123
 Di Porto P: *see* Crosignani B L119
 Domany E: an expansion of two particle harmonic oscillator wavefunction products 241
 Dondi P H: linearization and symmetry breaking in nonlinear SU(3) $\times$ SU(3) 1689
 Dondi P H: *see* Barnes K J 555
 Dowker J S: quantum mechanics and field theory on multiply connected and on homogeneous spaces 936
 Dracoulis G D: *see* Hartley A J L69
 Drake T E: *see* Curran C S L39
 Dunscombe P B, Blyth C O, McKee J S C and Pope C: neutron polarization from the $\text{D(d,n)}^3\text{He}$ reaction at 10.8 MeV incident deuteron energy L13
 Dunscombe P B: *see* Pope C L33
 Durell J L, Alderson P R, Bailey D C, Green L L, Greene M W, James A N and Sharpey-Schafer J F: lifetimes and decay modes of energy levels in ^{24}Na , ^{26}Mg and ^{26}Al 302
 Durell J L: *see* Bailey D C 596
 Durnford A M I A W: uniqueness of ^{56}Fe as a primary standard for atomic masses L106
 Durran R F: *see* Berry M V 166
 Dvořák S: Treloar's distribution and its numerical implementation 78
 Dvořák S: asymptotic behaviour of the chain molecule distribution function 85
 Edwards S F and Goodyear A G: the dynamics of a polymer molecule 965
 Edwards S F and Goodyear A G: the velocity distribution function for a polymer chain 1188
 Edwards S F: *see* Alexander-Katz R 674
 Ehrman J B: straggling of moderately relativistic electrons 1320
 Eilbeck J C: reflection of short pulses in linear optics 1355
 Eilbeck J C and Bullough R K: the method of

- characteristics in the theory of resonant or nonresonant nonlinear optics 820
- Eilbeck J C: *see* Gibbon J D L122
- Eilbeck J C: *see* Gibbon J D L132
- El-Bedewi F, Goned A and Girgis A H: energy spectrum and angular distribution of cosmic ray muons in the range 50-70 GeV 292
- El-Bedewi F and Shalaby M: study of energy levels of ^{29}Si via deuteron stripping 1624
- Evans R: *see* Berry M V 166
- Farmer C M: distribution functions in virial and hypervirial theory 1138
- Feneuille S and Crubellier A: quaternionic solutions for the relativistic Kepler problem with magnetic charges 944
- Ferguson H: *see* Blake P R 125
- Fincham D: multiple scattering model for pion-nucleon scattering and the slope of the Pomeranchuk trajectory 838
- Fincham D G and Wraight P C: a simple method for the analysis of damped oscillations 248
- Flanagan S: *see* Hartley A J L69
- Fletcher W H W: *see* Keen B E 152
- Fukui Y and Morita T: motion of an impurity atom in a lattice of harmonically coupled atoms and the stationary generalized Langevin equation 365
- Gabathuler E: vector mesons 327
- Gaunt D S: *see* Sykes M F 624
- Gaunt D S: *see* Sykes M F 640
- Gelletly W: *see* Hartley A J L69
- Ghosh P: *see* De A K 1236
- Gibbon J D: motion of a relativistic electron in a spatially modulated magnetic field L85
- Gibbon J D and Eilbeck J C: a possible N soliton solution for a nonlinear optics equation L122
- Gibbon J D and Eilbeck J C: the asymptotic form of the N soliton solution of the Korteweg-de Vries equation L132
- Gillespie W A: *see* Curran C S L39
- Girgis A H: *see* El-Bedewi F 292
- Golding G: hyperfine interactions of excited nuclei in highly ionized atoms 917
- Goldsack S J: multiparticle interactions 27
- Goned A: *see* El-Bedewi F 292
- Goodinson P A: a note on the gravitational field of a rotating radiating source L131
- Goodyear A G: *see* Edwards S F 965
- Goodyear A G: *see* Edwards S F 1188
- Gopala Rao R V and Narasimha Swamy K: selfconsistent PY2 and CHNC2 approximation. Evaluation of fifth virial coefficients 499
- Green L L: *see* Bailey D C 596
- Green L L: *see* Durell J L 302
- Green L L: *see* Nolan P J 454
- Greene M W: *see* Bailey D C 596
- Greene M W: *see* Durell J L 302
- Greenland P T and Irvine J M: K shell electron wavefunctions in complex atoms L10
- Gruppen C, Hamdan M A, Hansen S, Thompson M G, Woffendale A W and Young E C M: electromagnetic interactions of cosmic ray muons in iron I. Search for a charge asymmetry 1706
- Gruppen C, Hamdan M A, Hansen S, Thompson M G, Woffendale A W and Young E C M: electromagnetic interactions of cosmic ray muons in iron II. Momentum dependence of the interaction probabilities 1713
- Guttmann A J and Joyce G S: on a new method of series analysis in lattice statistics L81
- Guttmann A J: *see* Sykes M F 653
- Hall R L: many-particle systems 608
- Halliday I G, Islam S and Parry G: the ABST model and high energy scattering 853
- Hamdan M A: *see* Ayre C A L102
- Hamdan M A: *see* Gruppen C L706
- Hamdan M A: *see* Gruppen C L713
- Hancock N H, Hardisty G J and Read F H: mechanical simulation of the diffusion of long macromolecules L15
- Hansen S: *see* Gruppen C L706
- Hansen S: *see* Gruppen C L713
- Hardisty G J: *see* Hancock N H L15
- Hargreaves J C: composite models in general relativity 211
- Harris J F: *see* Whittington S G 411
- Hartley A J, Chapman R, Dracoulis G D, Flanagan S, Gelletly W and Mo J N: the ground state rotational bands in ^{150}Sm and ^{151}Sm L69
- Hartley B J: *see* Adjei S A 736
- Hartley B J: *see* Collins P A 726
- Harvey A L: comment on Coleman's theory of gravitation L30
- Heap B R: *see* Sykes M F 667
- Heller R B, Sugai I, Yueh-Li Cheng and Chiao L W: the beta spectrum of the fission products from ^{232}Cf and the associated inner bremsstrahlung radiation 1266
- Henery R J: the generalized Langevin equation 1312
- Horiguchi T: *see* Morita T 67
- Hue J and Mainard R: a method of resolving the Boltzmann quantum equation in the field of electronic relaxation 171
- Hume C J: *see* Ayre C A L53
- Hume C J: *see* Ayre C A L102
- Hunter D L: *see* Sykes M F 667
- Hynne F and Bullough R K: the Onsager reaction field as a screened self-interaction in refractive index theory 1272
- Irvine J M: *see* Greenland P T L10
- Islam S: *see* Halliday I G 853
- Islam M N: *see* Kellie J D 1090

- Jakeman E: the effect of heterodyne detection on the statistical accuracy of optical linewidth measurements L49 corrigendum 1738
- Jakeman E, Oliver C J, Pike E R and Pusey P N: correlation of scaled photon-counting fluctuations L93
- James A N: *see* Bailey D C 596
- James A N: *see* Durell J L 302
- James A N: *see* Nolan P J 454
- Jayasinghe E M: *see* Jones G D 1073
- Jelley J N: *see* Charman W N 773
- Jenkins J D: an equivalence theorem for a massive spin one particle interacting with Dirac particles in quantum field theory 705
- Jenkins J D: some remarks on an equivalence theorem for an interacting massive spin one particle in quantum field theory 1037
- Jenkins J D: the electromagnetic interaction of a massive spin one particle: some equivalence theorems and remarks 1461
- John T L and Williams K L: variational trial functions in quantum theory I. Bound states 1152
- John T L and Williams K L: variational trial functions in quantum theory II. Continuous spectrum 1165
- Johns K A: *see* Landsberg P T 1433
- Johnson R R: *see* Cage M E 1529
- Johnston A: *see* Curran C S L39
- Jones G D, Jayasinghe E M, Mulhern P J, Main I G and Twin P J: spin assignments for some higher excited states in ^{34}S 1073
- Jones R B: *see* Choudhary A R 981
- Joyce G S: lattice Green function for the simple cubic lattice L65
- Joyce G S: *see* Guttman A J L81
- Kamal J: *see* Tripathi V K 146
- Kapp L B: *see* Varey R H 1119
- Karakula S, Osborne J L, Roberts E and Tkaczyk W: the anisotropy of cosmic rays of galactic origin above 10^{17} eV 904
- Katsura S and Ohniami M: distribution of zeros of the partition function for the one dimensional Ising models 95
- Katsura S: *see* Ohniami M 1669
- Katz J: a note on energy extremal properties for rotating stars in general relativity 781
- Keck B W and Taylor J G: on the finiteness of nonderivative nonpolynomial Lagrangians 1473
- Keen B E: asynchronous excitation of a plasma instability L74
- Keen B E and Alcock M W: growth rate and frequency dispersion characteristics of drift waves in an RF collisional plasma 1095
- Keen B E and Fletcher W H W: nonlinear plasma instability effects for subharmonic and harmonic forcing oscillations 152
- Kellie J D, Islam M N, Syme D B C B and Crawford G I: neutron total cross section of ^{31}P between 0.75 MeV and 9.00 MeV 1090
- Kelly H C: spatial correlations and photon counting 104
- Kelly H C and Blake J G: a measurement of pulse separations for photoelectrons in the case of a Lorentz spectral line L7
- Kermode M W: a non-singular, local $^1\text{S}_0$ neutron-proton potential L125
- Khandekar D C and Lawande S V: path integral for a three body problem 812
- Khandekar D C and Lawande S V: path integration of a three body problem L57
- Killingbeck J: group algebras and tensor operators 1131
- Kiraly E, Kiraly P and Osborne J L: underground range fluctuations of high energy muons for various energy loss parameters 444
- Kiraly P: *see* Kiraly E 444
- Knight P L: effects of external fields on the Lamb shift 417
- Kondaiah E: *see* Thirumala Rao B V 468
- Krishna Rao J: spherical gravitational collapse with escaping neutrinos 479
- Kunz P D: *see* Cage M E 1529
- Lakshmana Rao A and Rama Rao J: cross sections and isomer ratios for some neutron capture reactions 1262
- Lakshminarayana V: *see* Satyanarayana G 1243
- Landsberg P T and Johns K A: Carnot efficiencies for moving reservoirs 1433
- Lawande S V: *see* Khandekar D C 812
- Lawande S V: *see* Khandekar D C L57
- Lee R: a two-particle Green function self-energy expansion 950
- Lees E W: *see* Curran C S L39
- Lin A L L: *see* Wang C P 1374
- Lind D A: *see* Cage M E 1529
- McCorkle R A and Bennett W H: electrostatic self-focusing of electron streams 524
- McKee J S C: *see* Dunscombe P B L13
- McKee J S C: *see* Pope C L33
- McKenzie D S: *see* Sykes M F 661
- McKenzie D S: *see* Sykes M F 667
- MacLeod A M and Milne G R: proton nuclear reaction cross sections in carbon and the $^{12}\text{C}(p,p'3\alpha)$ reaction mechanism at 13 MeV 1252
- Maeder D G: on a mechanical matching condition related to the detection limit for gravitational radiation L113
- Mahanty J and Ninham B W: dispersion forces between oscillators: a semiclassical treatment 1447
- Main I G: *see* Jones G D 1073
- Mainard R: *see* Hue J 171

- Mang H J: collective motions and single particle models 929
- Marder L: sources for Kerr type space-times in general relativity 605
- Martin J L: phase transitions in a one dimensional model of a ferromagnet; a transfer-matrix approach 1176
- Martin J L: selfavoiding walks on a crystal lattice; a new approach to the mean-square end-to-end length ρ_n L60
- Martin J L: *see* Sykes M F 661
- Mason D P: infinite conductivity in general relativistic magnetohydrodynamics L91
- Maugin G A: relativistic theory of magnetoelastic interactions I 786
- Maugin G A: remarks on dissipative processes in the continuum theory of micromagnetics 1550
- Milne G R: *see* MacLeod A M 1252
- Misell D L: addendum to 'image formation in the electron microscope I and II' 916
- Mitra S: *see* De A K 1236
- Mo J N: *see* Hartley A J L69
- Moore R W: *see* Adjei S A 736
- Moore R W: *see* Collins P A 726
- Moriarty K J M: *see* Adjei S A 736
- Moriarty K J M: *see* Barkai D 1364
- Moriarty K J M: *see* Collins P A 726
- Morita T and Horiguchi T: analytic properties of the lattice Green function 67
- Morita T: *see* Fukui Y 365
- Morris M J: interpolation theory for quantum mechanics 489
- Moya R P and Valatin J G: chiral currents as field variables in a semiclassical approach 348
- Mulhern P J: *see* Jones G D 1073
- Nagarajan T, Ravindranath M and Venkata Reddy K: precision analysis of ^{199}Au beta spectral shape 1395
- Nandi B C and Sinha M S: the momentum spectrum of muons at sea level in the range 5-1200 GeV/c 1384
- Nandi B C: *see* Ayre C A L53
- Nandi B C: *see* Ayre C A L102
- Naranan S: *see* Tonwar S C 569
- Narasimha Swamy K: *see* Gopala Rao R V 499
- Nash W F: *see* Blake P R 125
- Newton R H C: *see* Boyd T J M L43
- Nicholson J P: *see* Chisholm A 1404
- Nickle H H and Beers B L: algebraic solution of the Klein-Gordon equation 1658
- Ninham B W: *see* Mahanty J 1447
- Nolan P J, Bailey D C, Carr P E, Green L L, James A N, Sharpey-Schafer J F and Viggars D A: lifetime measurements for levels in ^{30}P between 3.7 and 4.7 MeV excitation energy 454
- Norcliffe A: relating the classical and quantal theories of angular momentum and spin 231
- Novello M and Rotelli P: the cosmological dependence of weak interactions 1488
- O'Hanlon J: Mach's principle and a new gauge freedom in Brans-Dicke theory 803
- Ohnishi M, Abe Y and Katsura S: distribution of zeros of the partition function of the antiferromagnetic Husimi-Temperley model 1669
- Ohnishi M: *see* Katsura S 95
- Oliver C J: *see* Jakeman E L93
- Osborne J L: *see* Karakula S 904
- Osborne J L: *see* Kiraly E 444
- Pant D N: the external field of a nonstatic isolated system in Bonnor's unified field theory L25
- Pant D N: *see* Tiwari R 394
- Parry G W: *see* Collins P A 726
- Parry G: *see* Halliday I G 853
- Patro A P: *see* Rama Rao M 763
- Pert G J: inverse bremsstrahlung absorption in large radiation fields during binary collisions—classical theory 506
- Pert G J: inverse bremsstrahlung absorption in large radiation fields during binary collisions—Born approximation I. Elastic collisions 1221
- Peters G I and Allen L: amplified spontaneous emission IV. Beam divergence and spatial coherence 546
- Peters G I: *see* Allen L 695
- Phythian R: comments on the paper 'On Phythian's perturbation theory for stationary homogeneous turbulence' 246
- Phythian R: a variational method in statistical mechanics 1566
- Pike E R: *see* Jakeman E L93
- Polonsky-Ostrowsky N: *see* Chen S H 1619
- Pope C, Buget N, Blyth C O, Dunscombe P B and McKee J S C: a search for spin dependent effects in the three body final state from the $^3\text{H}(d,n)p$ d reaction at 11.3 MeV incident deuteron energy L33
- Pope C: *see* Dunscombe P B L13
- Pourgoirides C M: *see* Barton J C 745
- Powar M S and Singh M: contribution of detour transitions to internal bremsstrahlung spectrum of ^{204}Tl 460
- Price H G: analogue resonances of low lying levels of ^{52}V in the $^{51}\text{V}(p,\gamma)^{52}\text{Cr}$ reaction 1524
- Purkayastha G, Sil N C and Banerjee S N: triton binding energy by the Faddeev approach with two-body local interactions 1495
- Pusey P N: *see* Jakeman E L93
- Rae J: *zitterbewegung* as a subdynamics 1438
- Ramamurty V V: *see* Satyanarayana G 1243
- Rama Rao J: *see* Lakshmana Rao A 1262
- Rama Rao J: *see* Siddappa K 877
- Rama Rao J: *see* Thirumala Rao B V 468

- Rama Rao M, Sen P and Patro A P: three quantum annihilations in silicone fluids 763
- Ravindranath M: see Nagarajan T 1395
- Ray D: neutrino processes in the lepton era of the universe and hot big bang cosmology L17
- Raychaudhuri P: the parton model, electromagnetic form factors of hadrons and high energy elastic π^+p scattering L97
- Read F H: see Hancock N H L15
- Redhead M L G: radiative corrections to coincidence experiments in high energy electron-electron and positron-electron scattering 431
- Reid J L: see Burt P B L89
- Roberts E: see Karakula S 904
- Roberts P D: see Sykes M F 624
- Roberts P D: see Sykes M F 640
- Roberts P D: see Sykes M F 653
- Robinson L C and Whitbourn L B: quantum mechanical description and noise analysis of the cyclotron resonance spectrometer-detector 263
- Rotelli P: see Novello M 1488
- Rotenberg M A: loss of gravitational mass of a rotating rod as outgoing gravitational radiation 198
- Rudziński W: summation of the virial expansion for the equation of state 1642
- Sarkar S C: see Barnes K J 555
- Satyanarayana G, Ramamurty V V and Lakshminarayana V: lifetime of the 321 keV ($9/2^-$) state in ^{125}Te 1243
- Saxena Y C: high energy muons (> 150 GeV) in extensive air showers 1502
- Scaife W G: the relative permittivity of the n alkanes from n pentane to n decane as a function of pressure and temperature 897
- Sen P: see Rama Rao M 763
- Sen Gupta N D: on the quantum theory of dispersion at resonance 401
- Shalaby M: see El-Bedewi F 1624
- Sharma S R and Bhatnagar T N: propagation of waves perpendicular to the magnetic field in a two-component warm plasma 471
- Sharpey-Schafer J F: see Bailey D C 596
- Sharpey-Schafer J F: see Durell J L 302
- Sharpey-Schafer J F: see Nolan P J 454
- Siddappa K, Sriramachandra Murty M and Rama Rao J: p wave neutron capture in medium and heavy weight nuclei 877
- Sil N C: see Purkayastha G 1495
- Simons S: the nonlinear $\phi\phi\phi$ model—a derivation and two applications 1537
- Singh M: see Power M S 460
- Singh O, Dass N and Varshneya N C: comments on the theoretical derivation of Wada's and Rao's relations L37
- Singhal R P: see Curran C S L39
- Sinha M S: see Nandi B C 1384
- Sirohi A P S and Srivastava M K: numerical calculation of the energy eigenvalues for a local potential 1639
- Slight A G: see Curran C S L39
- Soczka-Gut E: concerning Rao's rule L31
- Solimeno S: see Crocignani B L119
- Sreekantan B V: see Tonwar S C 569
- Sreekantan B V: see Vatcha R H 859
- Srinivasan S K and Sukavanam S: photocount statistics of gaussian light of arbitrary spectral profile 682
- Sriramachandra Murty M: see Siddappa K 877
- Srivastava M K: see Sirohi A P S 1639
- Stern M S: simple numerical solution of the partial-wave Lippmann-Schwinger equation 426
- Stern M S and Warburton A E A: finite difference solution of the partial-wave Schrödinger equation 112
- Stern M S and Warburton A E A: numerical determination of Regge poles in potential scattering 717
- Stern M S and Warburton A E A: S-wave eigenvalues of the Lippmann-Schwinger kernel for the exponential potential 1233
- Sugai I: see Heller R B 1266
- Sukavanam S: see Srinivasan S K 682
- Swain S: an exact solution of the multimode, multimode model Hamiltonian of quantum optics L3
- Swain S: an exact analysis of spontaneous emission by a single two level atom in the rotating wave approximation I. Analytic results 1587
- Swain S: an exact analysis of spontaneous emission by a single two level atom in the rotating wave approximation II. Numerical results 1601
- Sykes M F, Gaunt D S, Roberts P D and Wyles J A: high temperature series for the susceptibility of the Ising model I. Two dimensional lattices 624
- Sykes M F, Gaunt D S, Roberts P D and Wyles J A: high temperature series for the susceptibility of the Ising model II. Three dimensional lattices 640
- Sykes M F, Guttman A J, Watts M G and Roberts P D: the asymptotic behaviour of selfavoiding walks and returns on a lattice 653
- Sykes M F, Hunter D L, McKenzie D S and Heap B R: specific heat of a three dimensional Ising ferromagnet above the Curie temperature II 667
- Sykes M F, McKenzie D S, Watts M G and Martin J L: the number of selfavoiding rings on a lattice 661
- Syme D B C B: see Kellie J D 1090

- Tartaglia P: *see* Chen S H 1619
 Taylor J G: *see* Keck B W 1473
 Thielheim K O and Zöllner R: the theory of the longitudinal development of electromagnetic cascades 1054
 Thirumala Rao B V, Rama Rao J and Kondaiah E: neutron capture cross sections at 25 keV 468
 Thompson B V: a variational estimate of the lowest eigenvalue of the multiatom, multimode Hamiltonian of quantum optics 1453
 Thompson M G: *see* Ayre C A L53
 Thompson M G: *see* Ayre C A L102
 Thompson M G: *see* Grupen C 1706
 Thompson M G: *see* Grupen C 1713
 Tindle C T: *see* Walls D F 534
 Tiwari R and Pant D N: nonexistence of isolated charged monopoles in unified field theories 394
 Tkaczyk W: *see* Karakula S 904
 Tkaczyk W: *see* Wdowczyk J 1419
 Tonwar S C, Naranan S and Sreekantan B V: search for massive interacting particles near the cores of extensive air showers of energies of about 2×10^{14} – 10^{15} eV 569
 Tonwar S C: *see* Vatcha R H 859
 Tripathi V K and Kamal J: resonant excitation of ion plasma waves by vlf and whistler waves 146
 Trueman R E and Whittington S G: limiting ring closure probability on the square lattice 1664
 Turner J G: *see* Boyd T J M 132
 Turner J G: *see* Boyd T J M 881
 Twin P J: *see* Jones G D 1073
- Varey R H and Kapp L B: experimental evidence for supersonic ion flow in a low pressure plasma 1119
 Varshneya N C: *see* Singh O L37
 Vatcha R H, Sreekantan B V and Tonwar S C: study of high energy (25–10 000 GeV) interactions with a multiplate cloud chamber using Monte Carlo simulations for energy calibration 859
 Venkata Reddy K: *see* Nagarajan T 1395
 Viggars D A: *see* Bailey D C 596
 Viggars D A: *see* Nolan P J 454
- Walls D F and Tindle C T: nonlinear quantum effects in optics 534
 Wang C P and Lin A L L: particle production spectra and the internal structure of the hadrons 1374
 Warburton A E A: *see* Stern M S 112
 Warburton A E A: *see* Stern M S 717
 Warburton A E A: *see* Stern M S 1233
 Watt A: angular momentum projection from nonaxial intrinsic states 584
 Watt F: electron-microwave interactions 516
- Watts M G: *see* Sykes M F 653
 Watts M G: *see* Sykes M F 661
 Wdowczyk J, Tkaczyk W and Wolfendale A W: primary cosmic γ rays above 10^{12} eV 1419
 Wdowczyk J and Zujewska E: the possibility of a consistent explanation of various phenomena involving cosmic ray muons 1514
 Wells S C: *see* Ayre C A L53
 Wells S C: *see* Ayre C A L102
 Whalley M R: *see* Ayre C A L53
 Whalley M R: *see* Ayre C A L102
 Wheeler C B: space charge limited photoelectric emission in a plane parallel electrode geometry 1337
 Whitbourn L B: *see* Robinson L C 263
 Whittington S G and Harris J F: numerical investigation of closure approximations in the selfavoiding walk problem 411
 Whittington S G: *see* Trueman R E 1664
 Williams K L: *see* John T L 1152
 Williams K L: *see* John T L 1165
 Wilson A R: *see* Butt D K 1248
 Witteles E M and Carmi G: a soluble one dimensional model of an interacting Fermi gas: I 612
 Wolfendale A W: *see* Ayre C A L53
 Wolfendale A W: *see* Ayre C A L102
 Wolfendale A W: *see* Grupen C 1706
 Wolfendale A W: *see* Grupen C 1713
 Wolfendale A W: *see* Wdowczyk J 1419
 Woodison P M: *see* Boyd T J M L43
 Wragg A: *see* Collins R 1196
 Wright P C: *see* Fincham D G 248
 Wright P G: revised thermodynamic relations for λ transitions in mixtures I. Examination in terms of properties generally relevant 1004
 Wright P G: revised thermodynamic relations for λ transitions in mixtures II. Special relations for Curie points and Néel points 1015
 Wright P G: revised thermodynamic relations for λ transitions in mixtures III. The saturated vapour of solutions of ^3He in liquid ^4He below their λ temperatures 1018
 Wright P G: Pippard's relations applied to certain λ transitions in dielectric and magnetic materials 1206
 Wyles J A: *see* Sykes M F 624
 Wyles J A: *see* Sykes M F 640
- Young E C M: *see* Grupen C 1706
 Young E C M: *see* Grupen C 1713
 Yueh-Li Cheng: *see* Heller R B 1266
- Valatin J G: *see* Moya R P 348
- Zöllner R: *see* Thielheim K O 1054
 Zujewska E: *see* Wdowczyk J 1514